Thermal effects on dilepton production
from pion-annihilation   *

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Recently the CERES-collaboration has reported [1] a considerable enhancement in the dilepton spectrum over a hadronic cocktail in the invariant mass range $300\,\mathrm{MeV} \leq M_{inv} \leq 500\,\mathrm{MeV}$. Part of this enhancement is certainly due to pion annihilation which has not been taken into account in the CERES-cocktail. In a pion gas the pion-annihilation rate is modified by interactions with the environment in two ways. First, the pion form factor is reduced close to the mass of the ρ-meson [2]. This is a direct consequence of chiral restoration, where some of the strength of the current-current correlation function is moved to higher masses, around that of the a_1 meson. Secondly, the pion dispersion relation is modified in a pion gas due to the attractive p-wave interaction. As a result the pion annihilation cross section is enhanced for low invariant masses, just above the two pion threshold. A similar enhancement has been proposed by Gale and Kapusta in the context of BE-VALAC energy heavy ion collisions, where the pion dispersion relation is modified due to the interaction with nucleons forming deltas. The combined effect of both in-medium modifications is to flatten the invariant mass spectrum due to pion annihilation in qualitative agreement with the CERES measurement (see figure 1). A quantitative comparison, however, requires to take into account the experimental acceptance cuts as well as the proper expansion dysnamics of the system created in the heavy ion reaction [4].
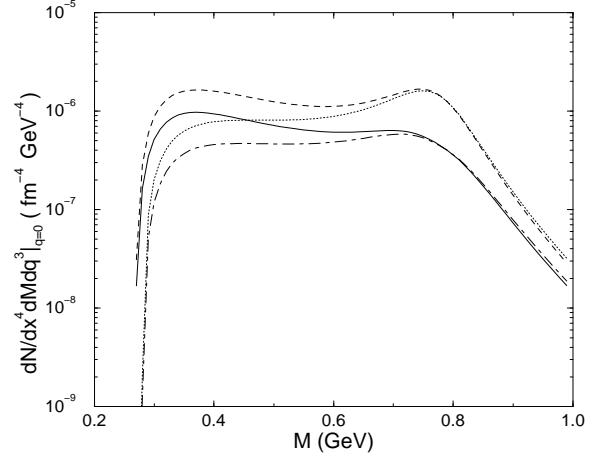

Figure 1: Dilepton production rate from pion-annihilation at $T = 160\,\mathrm{MeV}$. The dotted line is the result obtained without medium effects, the dashed line is that including modifications of the pion dispersion relation. The dashed-dotted line is the production rate obtained by only taking into account the in medium pion form-factor and the solid line is the result when both effects are taken into account.

[1] G. Agakichiev et al., Phys. Rev. Lett. 75 (1995) 1272.
[2] C. Song, S.H. Lee and C.M. Ko, Phys. Rev. C52 (1995) R476.
[3] C. Gale and J. Kapusta, Phys. Rev. C35 (1987) 2107.
[4] V. Koch and C. Song, Phys. Rev. C54 (1996) 1903.